User's Manual

COBHAM

The most important thing we build is trust.

Messenger High-Power Transmitter

(MHPT)

100-M0075X1
06/17/09

Cobham Surveillance
GMS Products
1916 Palomar Oaks Way Ste 100
Carlsbad, CA 92008
T: 760-496-0055
F: 760-496-0057
www.cobham.com/gms

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1.0 Acronyms

This section lists and describes the various acronyms used in this document.

Name	Meaning
16 QAM	16-state Quadrature Amplitude Modulation
64 QAM	64-state Quadrature Amplitude Modulation
A/V	Audio/Video
AES	Advanced Encryption System (32 bit)
ABS	Messenger Basic Scrambling (8 bit)
ASI	Asynchronous Serial Interface
COFDM	Coded Orthogonal Frequency Division Multiplexing
CVBS/Y	Composite video/Luminance with S-video
C	Chroma video
D/C	Down-Converter
DDR	Digital Diversity Receiver
DVB-T	Digital Video Broadcasting-Terrestrial
FEC	Forward Error Correction
GUI	Graphical User Interface
I/O	Input/ Output
Kbaud	Kilobaud per second
Kbps	Kilobits per second
Mbps	Megabits per second
MDL	Messenger Digital Link
MDR	Messenger Digital Receiver
MDT	Messenger Digital Transmitter
MER	Modulation Error Rate
MPEG	Moving Picture Experts Group
MSR	Messenger Smart Receiver
NTSC	National Television System Committee
PAL	Phase Alternation Line
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RX	Receiver
SDI	Serial Digital Interface
SDML	Standard Definition Messenger Link
SDMT	Standard Definition Messenger Transmitter
S/N	Signal-to-Noise Ratio
THD	Total Harmonic Distortion
TX	Transmitter
VDC	Volts (Direct Current)

2.0 Theory of Operation

The MHPT accepts either a SDI, ASI, composite, component or a S-video signal, analog stereo audio inputs (Mic or Line level), and a RS232 data input. The video is compressed according to MPEG-2 specifications. However, unlike other MPEG-2 systems, all of the high-frequency video signal components are preserved. The audio is converted to a 728kb/s stream. The audio, video and data packet streams are multiplexed with basic service data to indicate the service name. The stream can be scrambled with either a simple fixed-key scrambling or AES scrambling system to provide protection in sensitive applications.

The video and audio are compressed (ASI data streams are passed through bypassing the MPEG encoder) according to MPEG specifications (Video MPEG-2 and Audio MPEG-1 layer II). The MPEG-2 supports 4:2:0 Chroma sampling, MP@ML and SP@ML profiles and maintains the original signal's video fidelity. The audio and video program element streams are multiplexed with basic service data to indicate the service name into a DVB compliant Transport Stream (TS).

The TS stream is then sent through a DVB-T compliant FEC encoder and COFDM modulator. This is output from the FPGA based modulator core as digital I/Q signals that are converted to Analog I/Q signals and applied to an I/Q Modulator. The LO that provides the carrier to this I/Q modulator comes from a low phase-noise programmable synthesizer. The modulated RF output of the I/Q modulator IC is sent through amplifier chain and ultimately output to the outside world. Programmable attenuators in the RF processing chain provide signal leveling.

One of the biggest problems encountered in the transition from an analog to a digital A/V Platform has been the inherent digital coding delays that in some digital systems are 400ms or more. The MHPT/MSR combination employs a specially designed 'low delay' coding technology, which provides an end-to-end latency of approx. 198ms without the introduction of any further MPEG encoding artifacts. This ensures that the picture you see is what is happening now - crucial for applications such as sports coverage, surveillance, and law enforcement, where personnel are reacting to real-time events

The transmitter is microprocessor controlled. Normally the transmitter is controlled either through an RS-232 or USB interface via either GMS' MS Windows control SW or a simple command line interface.

3.0 Hardware Overview

Figure 1 shows the hardware configuration of the MHPT:

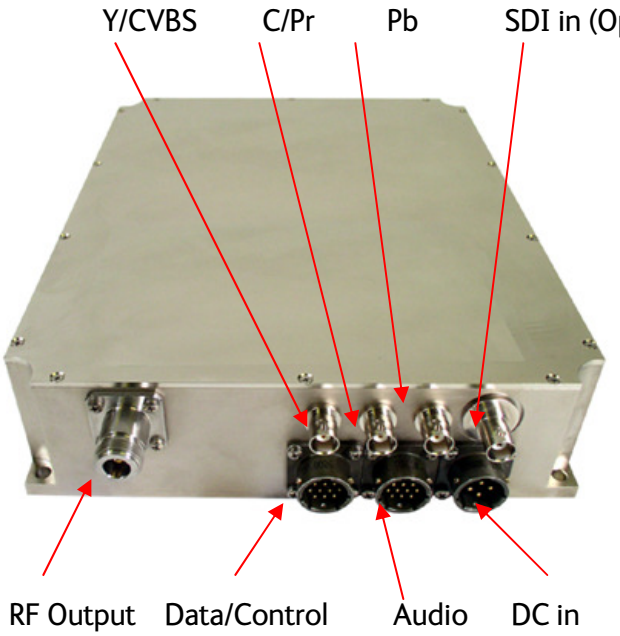


Figure 1 – MHPT Connectors

3.1 MHPT Connectors

3.1.1 RF Output

The MHPT uses a female 'N" type bulkhead connector for its 'RF Output' port.

Note: Transmitters should not be powered on without a load. Doing so could cause damage to the output PA. A proper heat sink is also required.

3.1.2 Data/Control

The Data/Control port provides a two-port interface of RS-232 signals and a USB port. The RS232 Data port is designed for user data input. The RS232 Control port and/or USB are used for control and monitoring of the MHPT unit using GMS' MS Windows-based Configurator software program. GMS cable (780-C0217) is used to connect to the Data/Control connector. See drawing 100-C0217 for RS232 and USB connections (Appendix C).

3.1.3 Audio

Two channels (Audio1, Audio2) of balanced audio input are provided. GMS cable 780-C0218 is used to connect to the Audio connector. See drawing 100-C0218 for connections (Appendix B).

3.1.4 DC in

The MHPT accepts 12 or 24 VDC input power (depending on configuration)

GMS cable (780-C0219) is used to connect to the DC in connector. See drawing 100-C0219 for power connections (Appendix A).

3.1.5 Y/CVBS

This connector is a dual use input connector; a) Composite Video or b) Luminance when used with Component video.

3.1.6 C/Pr

This connector is a dual use input connector; a) Chroma when used with S-Video or b) Pr, the red component minus the luminance information when used with Component video.

3.1.7 Pb

This is the blue component minus the luminance information used with Component video.

3.1.8 SDI (Optional)

This input is used for SDI (Serial Data Interface) input (This option can be purchased separately)

4.0 Software Overview

Configuration, control and monitoring of the MHPT unit is accomplished by using GMS' optional (sold separately) MS Windows-based MHPT Configurator software program. This Graphical User Interface (GUI) program provides the end user with a straightforward way to interface with the MHPT. During normal operation, once a HP-MDL link is established, the MHPT Configurator GUI does not need to be active and can be disconnected from the MHPT.

4.1 System Requirements

The MHPT Configurator program has been developed and tested on Windows 2000, Windows XP and Windows NT. Although the MHPT Configurator program may work properly on other operating systems, only the Windows 2000, Windows XP and Windows NT environments have been used at GMS and no support or assistance can be provided concerning other operating systems.

4.2 Installation

The following instructions outline the installation process for the MHPT Configurator program:

1. Insert provided CD-ROM into computer.
2. Click on 'setup.exe' file. This will launch the GMS_HMT Configurator Setup program and several initial setup files will begin to be copied onto the computer.
3. After the initial setup files are copied over, the GMS_MHPT Configurator Setup program will prompt the user to close any applications that are running. Once all other programs are exited, click on the 'OK' button.
4. The GMS_MHPT Setup program will prompt the user to click on the 'computer icon' button to begin installation. If desired, the user can change the destination directory from the default. Click on the 'computer icon' button.
5. The GMS_MHPT Setup program will then prompt the user to 'Choose Program Group'. If desired, the user can change the program group from the default. Click on the 'Continue' button.
6. After installing the MHPT Configurator program, it will display a window indicating that setup was completed successfully. Click 'OK'.

4.3 MHPT Configurator Functions

The MHPT Configurator program provides the user access to many different configuration, control and monitoring options. When the MHPT Configurator program is launched, the screen shown in Figure 2 is displayed. The user should first select the serial port their computer is connected to via the Serial Port Selector and Status region. If the selected serial port is valid, the gray-colored status box will show 'Ready. To configure a SDMT, select the 'SDMT' box in the Device Selector region. Once the 'SDMT' box is selected, the screen shown in Figure 3 is displayed. The MHPT Configurator program contains function buttons and all the configurable settings available on a MHPT. The following sections explain, in detail, the various options.

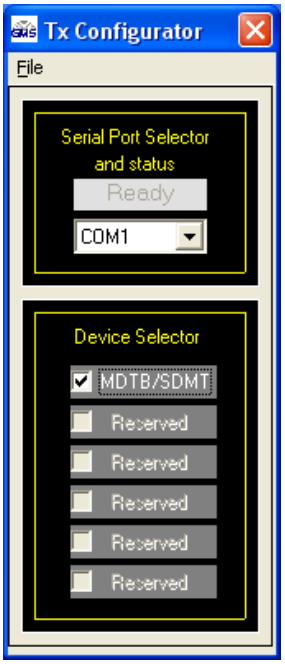


Figure 2 – MHPT Configurator Main Screen

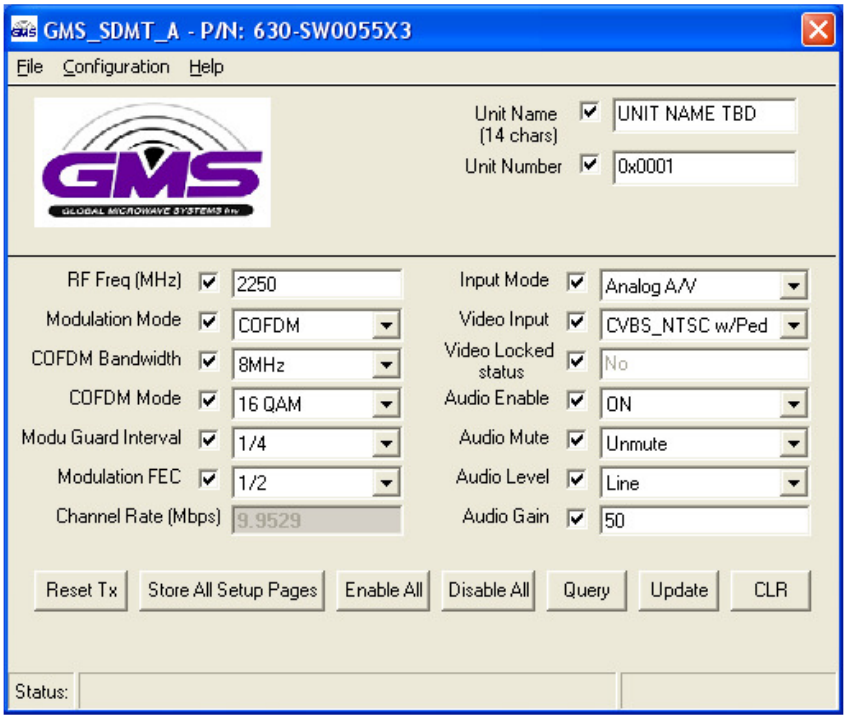


Figure 3 - MHPT Configurator Main Screen

4.3.1 Function Buttons

- "**Reset Tx Button**: Clicking on this button re-boots the transmitter to an initial known state. Note that it takes approximately 20 seconds to fully initialize the transmitter.

- "**Store All Setup Pages" Button**: Clicking on this button will store all setup pages, even if they are not shown.

- "**Enable All" Button**: Clicking on this button enables all the check boxes on the screen. This operation is done to prepare all the fields to be written to (or read from). Alternatively, the end user can individually select a given field by using the mouse and clicking its corresponding check box

- "**Disable All" Button**: Clicking on this button disables all the check boxes on the screen. This operation is done to inhibit all the fields to be written to (or read from). Alternatively, the end user can individually deselect a given field by using the mouse and clicking its corresponding check box.

- "**Query" Button**: Clicking on this button performs a read operation on all the fields that have their check box enabled. Once clicked, all the selected fields will be read back reflecting their current configuration.

- "**Update" Button**: Clicking on this button performs a write operation on all the fields that have their check box enabled. Once clicked, all the selected fields will be written to with the value denoted in their respective field.

- "**CLR" Button**: Clicking on this button clears out all fields on the screen, regardless of whether the fields' check boxes are selected or not. This button proves useful when the end user wants to verify that a write operation has been correctly performed. An example scenario would be to 1) enable all fields, 2) change desired field(s), 3) perform a 'Update' (write) operation, 4) perform a 'CLR' operation and 5) perform a 'Query' operation. As a result of the 'Query' operation, the fields on the screen should all update to those values that were written during the 'Update' operation.

4.3.2 Field Definitions

There are several different fields that can be configured by the SDMT Configurator. The fields located in the main screen of Figure 3 and their associated values are defined in Table 1 below. Also noted in the table is whether the field is read, write-able or both

Table 1 - MHPT Field Definitions

Field	R/W	Description
Unit Name	R/W	Allows the user to assign a unique unit name to the MHPT.
Unit Number	R/W	Allows the user to assign a unique unit number to the MHPT
RF Freq (MHz)	R/W	RF output frequency. Desired frequency is entered in MHz (i.e., 1.296GHz would be entered as 1296). Default frequency step size is 500KHz. For S2 band it's 250KHz.
Modulation	R/W	Modulation mode. Desired modulation mode is

Field	R/W	Description
Mode		selected from the following values*: C-OFDM (default) Off (shuts off modulation)* or *I/Q CAL ON (puts unit in calibration mode).*
COFDM Bandwidth	R/W	**COFDM** transmit bandwidth. Desired bandwidth is selected from the following values: *6, 7 or 8 MHz.*
COFDM Mode	R/W	**COFDM** modulation type. Desired **COFDM** modulation type is selected from the following values: *QPSK, 16 QAM* or 64 QAM (only in ASI mode)
Mod Guard Interval	R/W	Modulation guard interval size. Desired modulation guard interval size is selected from the following values: *1/32, 1/16, 1/8 or ¼. (not all values available to MHPT and MHPT-S units, configuration type dependent).*
Modulation FEC	R/W	Modulation FEC (Forward Error Correction) rate. Desired modulation FEC rate is selected from the following values: *½, 2/3, ¾, 5/6, 7/8* (*not all values available to MHPT and MHPT-S units, configuration type dependent.).*
Channel Rate (Mbps)	R	Channel rate is displayed based on parameters selected such as COFDM mode, FEC and Guard Interval. Channel rate is limited to 15Mbps when Analog Video input or SDI input is selected.
Input Mode	R/W	Choice between Analog video, SDI, or ASI
Video Input	R/W	Video input format. Desired video input format is selected from the following values: *PAL, NTSC w/ Pedestal, NTSC, S-video PAL, S-video NTSC, and Component Video. Some of these choices may or may not be shown in the pull down box depending on which user profile has been loaded.*
Video Locked Status	R	Analog video lock status. This read-only field indicates that the MHPT has line-locked onto the analog video input signal [*not applicable when the "Input Mode" is set to either SDI or ASI]*
Audio Enable *	R/W	Analog audio encoder enable. Desired mode of operation of the audio encoder is selected from the following values: *Off or On.*
Audio Mute *	R/W	Choice between *mute* or *un-mute* audio stream
Audio Level *	R/W	Choice between *mic* or line *level* audio
Audio Gain *	R/W	Adjustable gain between 0- 100

* *Not applicable for embedded audio applications.*

4.3.3 Pull-Down Menu Definitions

There are several different pull-down menus that are included in the MHPT Configurator program. Each of these pull-down menus contains further user-configurable options or commands. The following sections describe these menus in detail.

4.3.3.1 File

This pull-down menu offers to exit the MHPT Configurator program. Alternatively the 'X' box in the upper right hand corner of the window can be used to exit the program. The "Store All Setup Pages" button on the main menu will save all parameters.

4.3.3.2 Configuration

This pull-down menu contains several different configuration options. These are outlined below:

- ***Special Setup***
  - ***Scrambling Mode (Option,this menu not available if option is not purchased)*** – This pull down menu displays the following (see Figure 4A & 4B):
    - ***OFF***- Scrambling (Encryption) turned off (disabled).
    - ***AES,Never Store the key in the TX*** – Scrambling is turned on (Enabled). When scrambling is turned on, a key code (a series of 32 Hex characters) must be entered. Entering the key code is discussed in the following section (Scrambling Key). In this mode the key code is not stored in the transmitters memory. When power is removed the key code will be lost and must be re-entered when power is re-applied. The same key code must be entered in the DDPC of the MSR. See DDPC manual 100-M0070.
    - ***AES, Store the key in the Tx*** – Scrambling is turned on (Enabled). In this mode the key is stored in the transmitters memory. When power is removed the key code will not be lost.
    - ***Query*** – Clicking this button performs a read operation which will read back the current scrambling mode configuration.
    - ***Apply*** – Clicking this button will perform a write operation of the selected mode.
    - ***Exit*** - Exit the scrambling mode.

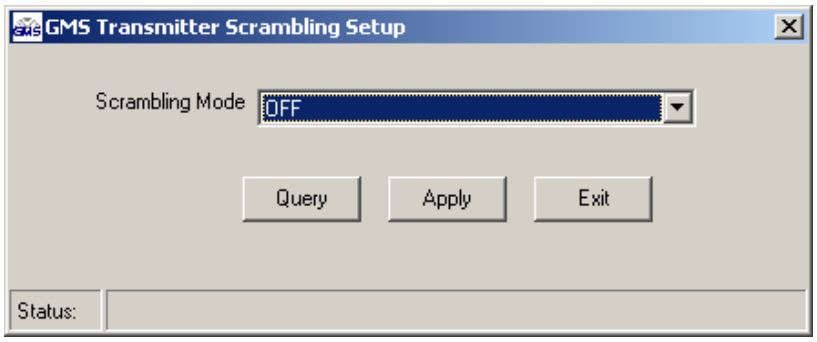


Figure 4A– Scrambling Mode setup

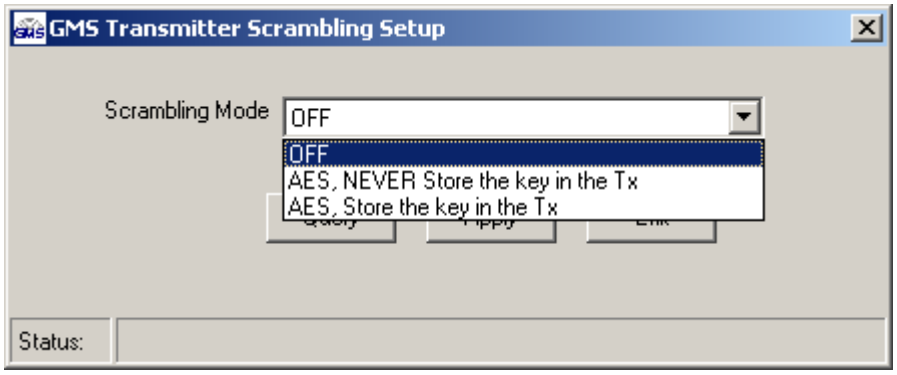


Figure 4B – Scrambling Mode setup

- ***Scrambling Key (Option, This menu not available if option not purchased))*** – This menu displays the following (see Figure 5):

  - ***Enter Scrambling Key from Keyboard –*** The 32 character key code can be manually entered from the keyboard. The characters must be Hex numbers. When the numbers have been typed, use the ***Apply*** button to enter the code.
  - ***Load Scrambling from a file –*** The key code can be selected from a file. The ***browser*** button can be used to search thru the Directory for a file containing the key code. Once a path has been established it can be saved using the ***Save Path*** button. The ***Load Key from File*** is used to retrieve a key code from a file as specified by the path. Use the ***Exit*** key to close this window.

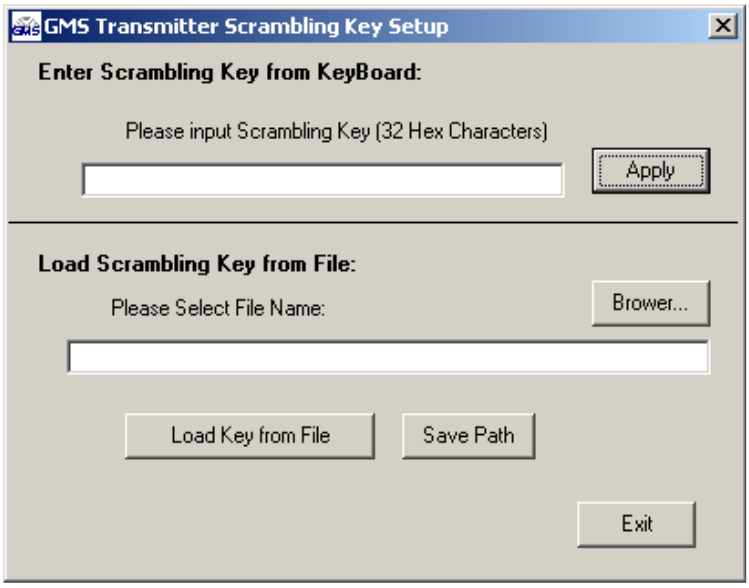


Figure 5- Scrambling Key Setup

- ***Others*** (see figure 6)- This menu displays the following:

  - ***RF Output attenuation –*** The RF out can be attenuated in 1 dB increments up to a frequency band defined max.
  - ***COFDM Spectrum Inversion*** - choices include normal or inverted. The transmitter is configured with the receiver it ships with and the inversion mode shouldn't have to be changed. However if a different receiver is used, it may be necessary to change the inversion mode. Some receivers will accept either inversion mode. Check the parameters of the receivers to ensure the correct inversion mode is selected.
  - ***Sleep Mode***-Can be used to put transmitter in a sleep mode, a low power mode where the encoder functions and many of the power regulators are shut down enabling a saving in current (approx. 40%) when transmitter is not active.
  - ***Frequency switch*** – choices offered are enabled or disabled. These are the four frequency select switches discussed under section 5.1.2. If disabled the switches will not respond to changes (frequency changes could still be accomplish by changing the "RF FREQ MHz" field in the GMS SDMT control software. Enabling them allows the frequency to be changed when the switches are moved. Factory default enables the switches. Keep in mind that you must click on the "Store All Setup Pages" button for any new selection to take place.
  - ***Video Profile*** - Pull down box offers a choice between the SP@ML profile (default profile) and the MP@ML profile.
  - ***GOP Length***- Group of pictures size (1-19) can be adjusted by selecting various values from the pull down boxes.

- ***Ctrl Port Baud Rate***- The control port baud rate menu allows different baud rates to be selected when attached to the PC RS232 port. 115200-baud rate is the default value. Some computers may need the baud rate adjusted for optimal communications
- ***Factory Setup –*** reserved for factory use and is password protected.

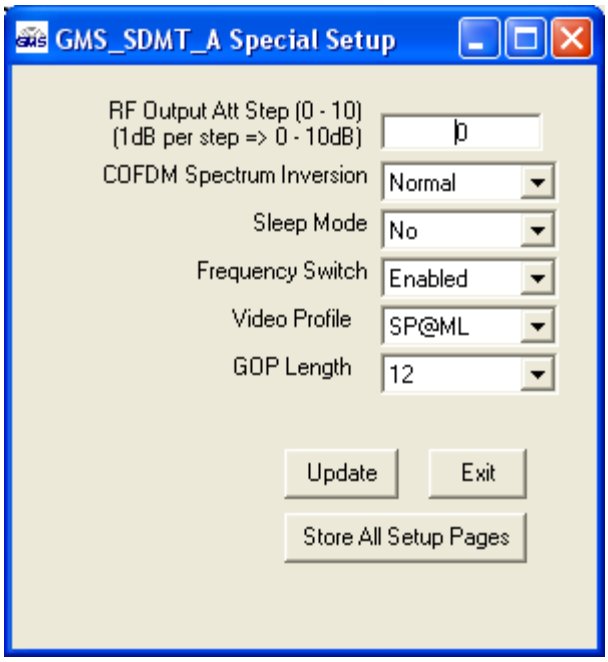
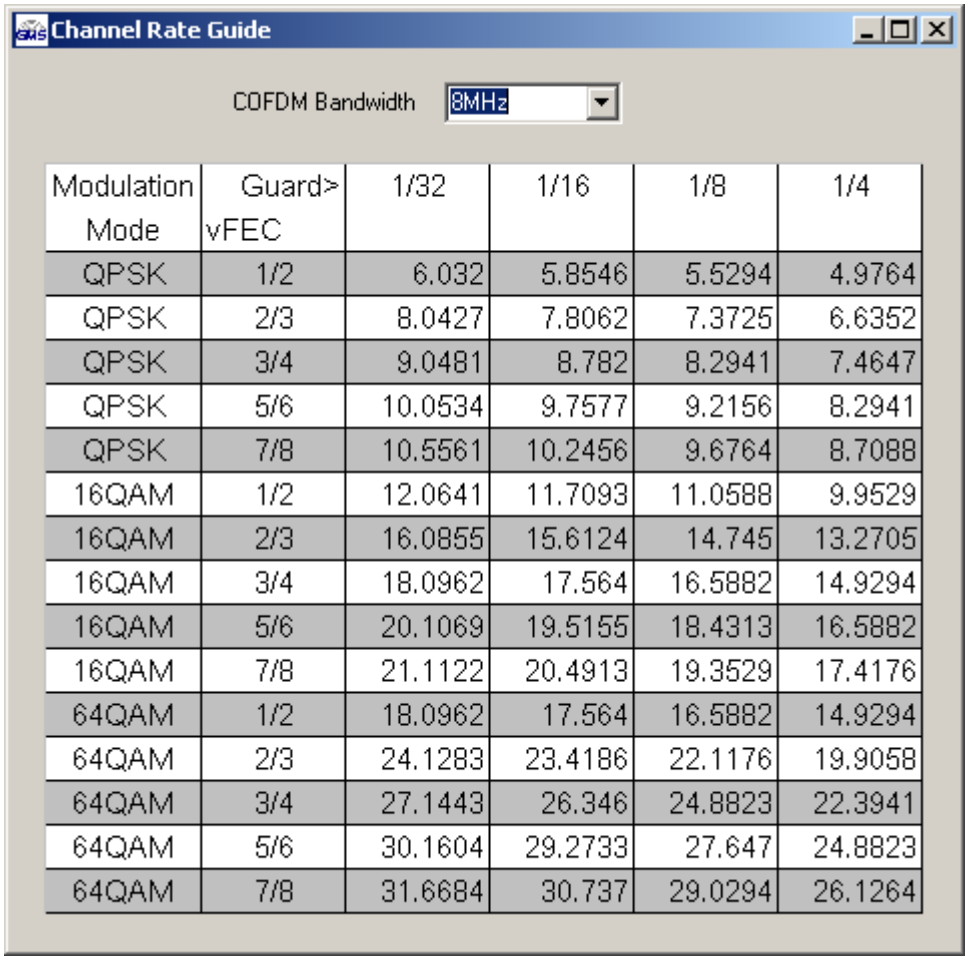


Figure 6 – Others Menu Screen

4.3.3.3 Help

This pull-down menu contains information about the SDMT firmware and the SDMT Configurator software. This information is outlined below:

- *Channel Rate Guide*: This selection pulls up a table which displays the relationship between the Modulation mode, Modulation Guard Interval and FEC mode in which the channel rate (Mbps) is derived. Table values will change depending on which COFDM Bandwidth is selected. See figure 7. Also keep in mind that all values may not be available, they are SDMT configuration type dependant.
- *FW version*: This selection pulls up a window that displays the SDMT Software Version date, the FPGA Version and Serial Number. See Figure 8.
- *About*: This selection pulls up a window that displays the Version Number of the GMS SDMT Configurator program. See Figure 9.



Modulation Mode	Guard> vFEC	1/32	1/16	1/8	1/4
QPSK	1/2	6.032	5.8546	5.5294	4.9764
QPSK	2/3	8.0427	7.8062	7.3725	6.6352
QPSK	3/4	9.0481	8.782	8.2941	7.4647
QPSK	5/6	10.0534	9.7577	9.2156	8.2941
QPSK	7/8	10.5561	10.2456	9.6764	8.7088
16QAM	1/2	12.0641	11.7093	11.0588	9.9529
16QAM	2/3	16.0855	15.6124	14.745	13.2705
16QAM	3/4	18.0962	17.564	16.5882	14.9294
16QAM	5/6	20.1069	19.5155	18.4313	16.5882
16QAM	7/8	21.1122	20.4913	19.3529	17.4176
64QAM	1/2	18.0962	17.564	16.5882	14.9294
64QAM	2/3	24.1283	23.4186	22.1176	19.9058
64QAM	3/4	27.1443	26.346	24.8823	22.3941
64QAM	5/6	30.1604	29.2733	27.647	24.8823
64QAM	7/8	31.6684	30.737	29.0294	26.1264

Figure 7 - Channel Rate Guide

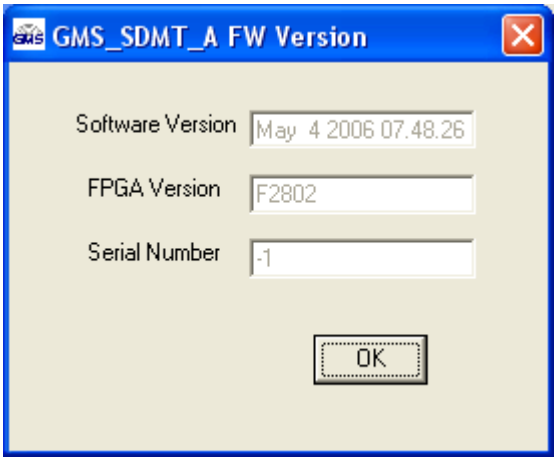


Figure 8 - FW Version

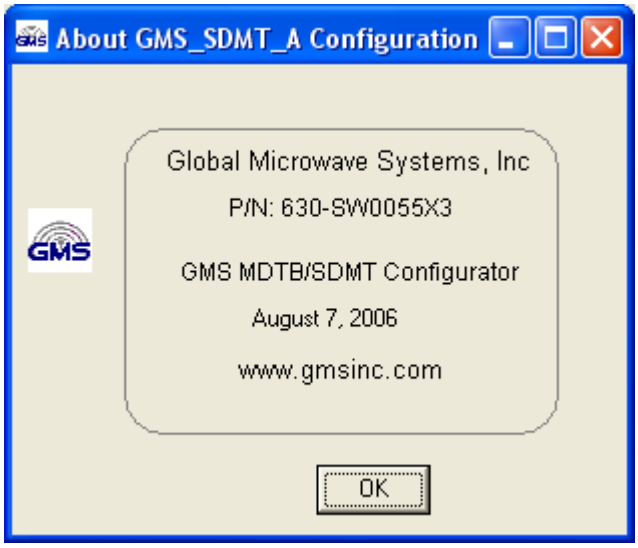


Figure 9 - About

5.0 Getting Started

The standard MHPT kit includes the following items:

- MHPT unit (Example p/n MHPTS2HC0N1)
- MHPT Power cable (GMS p/n 780-C0219)
- MHPT Audio cable (GMS p/n 780-C0218)
- MHPT Communication cable (GMS p/n 780-C0217) (Data, Control interfaces)

NOTE: Based on customer application GMS may deliver additional cables and antennas. Contact GMS for further information.

The MHPT is pre-configured by GMS prior to shipment (based on customer requirements), thus is ready to work "right out of the box".

5.1 Initial Checkout

Prior to installing a MHPT unit into the desired target environment, an initial checkout should be performed to ensure proper operation of the unit. The initial checkout consists of configuring a basic HP-MDL (High Power Messenger Digital Link).

Figure 9 shows a basic interconnection configuration to establish a wireless HP-MDL (NOTE: Receivers, down converters (D/C) units and their associated hardware are sold separately). The steps necessary to set up the configuration, shown in Figure 10, is shown below.

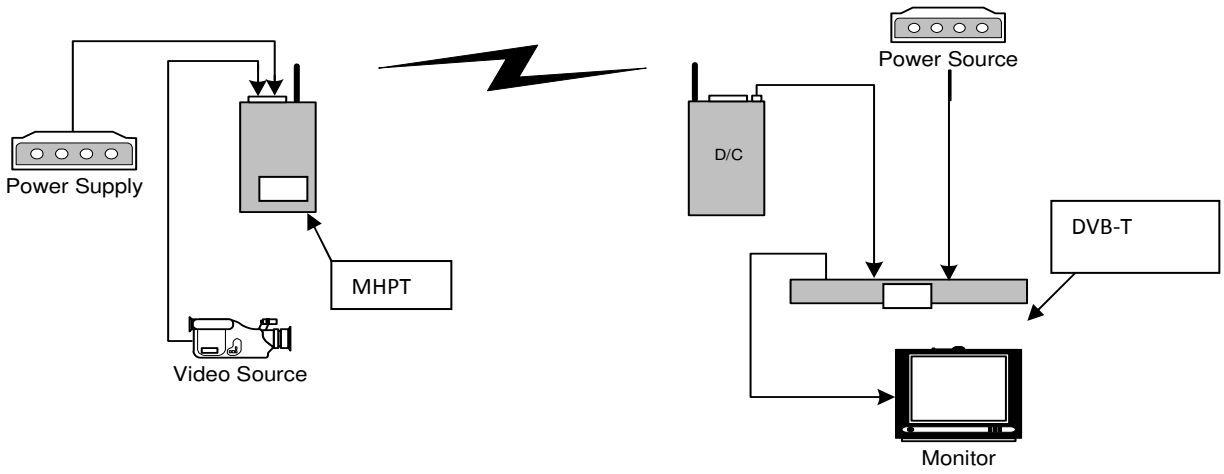


Figure 10 - Basic SDML Setup

1. Install omni-directional antennas onto the MHPT RF output port and Down- Converter (D/C) RF input port. ***Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working. A proper heat sink is also required.***
2. Attach the power cable (780-C0219X1) to the MHPT unit.
3. Attach a RF cable from the D/C IF output port to RF in port of the receiver.
4. Attach a composite video source to MHPT BNC video input (marked CVBS/Y). S-video and Component video input are also available. Attach a video cable from one of the BNC video output ports on the receiver to a video monitor.
5. To prepare to power the MHPT unit, attach the red and black wires of the power cable to +12V (or +28V) terminal and ground of power supply, respectively. NOTE: The power supply (for the transmitter) needs to be able to provide at least 12 Amps of current at a nominal +12VDC input if configured for 12 V input. (6 Amps if configured for 28 V input)
6. Turn on the video source and video monitor equipment.
7. Apply power to the MHPT and the receiver unit Also ensure the down converter is powered (+12 Vdc to pin 1, GND to pin 3 of the DB-9 pin connector located on the bottom side of the D/C). If the down converter is installed in a pole mount box it will have a power switch on the side of the unit. Ensure the switch is turned to the "On" position.
8. After approximately 20 seconds, the link should be established and video provided by the source should be displayed on the monitor. If a link is not established, insure that the receiver (MSR) is tuned to the same frequency and bandwidth as the transmitter. (See MSR manual 100-M0061)

The initial checkout described above is simply to check the basic video operation of the MHPT unit. For further details on monitoring and controlling the MHPT using GMS' optional MS Windows-based MHPT Configurator software program, see Section 6.0.

6.0 Specifications

The following sections outline the overall specifications for the SDMT unit.

6.1 Video Encoding

Interfaces: SDI (optional), ASI (optional), Component, Composite or S-Video Input
Standards: NTSC or PAL
Compression Standard: MPEG-2 (per ISO/IEC 13818-2)
Profiles: MP@ML, SP@ML
Video Bit Rate: 3.7Mbps to 15Mbps (MP@ML)
Chrominance Profile: 4:2:0
Line Standard: 525 or 625
Horizontal Resolution: 704 pixels
Vertical Resolution: 576 (625 line) and 480 (525 line)
System Latency end to end delay: 198mS with MHPT/MSR combination in SP@ML mode.

6.2 Audio Encoding

Analog Audio: Dual, Line-Level or Mic-Level, Differential or Single-Ended, Clip Level 12dBm
Impedance: 600 Ohms input impedance (changeable to 2K Ohms)
Compression Standard: MPEG layer II
Audio Enable: On or Off
Bit Rates: 256Kbit/s/ch
Sampling Frequency: 32kHz, 44.1kHz or 48kHz
THD: < 0.1% maximum
Response: 20Hz to 12kHz, +/- 0.25dB
Crosstalk: >55dB minimum
S/N: >60dB RMS

6.3 Transport Stream

Standard: per ISO/IEC 13818-1
Packet Size: 188 byte
Bit Rate: Automatically set from active service settings.

6.4 RS-232 Interfaces/RCU/USB

Control Port: 3-wire interface (Tx,Rx,Gnd)
USB 1.0
RCU A remote portable control unit is also available
USER DATA: RS232, Asynchronous,8 Bits,No Parity, 1 Stop Bit
Data rate selectable up to 38.4 kBaud. PID selectable.

6.5 COFDM RF Output

Output Frequency: 1 to 7 GHz (In-Bands).
Frequency step size is 500 KHz for all bands except S2 (1999-2500 MHz) which is 250 KHz.
Bandwidth: Selectable 6, 7 or 8 MHz
Output Power: Up to 15 W (Model dependant)
Connector: **N-F**
Note: Transmitters should not be powered on without a load. Doing so could cause the output PA to stop working. A proper heat sink is also required.

6.6 Modulation

Modulation Type: COFDM w/ QPSK, 16 QAM or 64 QAM.
FEC: ½, 2/3, 5/6,¾, 7/8
Guard Intervals: 1/32, 1/16, 1/8, ¼
Spurious: 50dBc
Number of C-OFDM Carriers: 2k
C-OFDM MER: > -45dB
Standard: DVB-T compliant

6.7 Power

DC Input Voltage Range: 24 to 32 V @ 5.3Amps (Opt)
9 to 15 V @ 10.6 Amps (Opt)

6.8 Physical Dimensions (without mating connectors)

Dimension: 8.0 in. (W) x 10.25 in. (D) x 2.08 in. (H)
(20.32 cm x 26.04cm x 5.28cm)
Weight: 8.57 lbs. (3.88 kgs)

6.9 Environmental

Operational Temperature: -10 to +70 °C
Humidity: Up to 100% (non-condensing)

6.10 MHPT Special Features

Video Only Mode

In applications where audio is not required, the audio channels can automatically be switched off. Bit rate is automatically switched over to the video channel in this situation.

Monochrome Video Mode (custom option, consult factory)

Surveillance applications often do not require chrominance data in the video. HPMT has been provided with a luminance (monochrome) only mode. When in this mode, bit rate is saved giving sharper monochrome pictures.

Security Option

The HPMT can optionally be provided with an Advanced Encryption System (AES) for protecting the signal in sensitive applications.

7.0 The D/C (Down Converter)/IF frequencies explained

7.1 IF Frequencies

- GMS' MDRs (Messenger Digital Receivers) and MSRs (Messenger Smart Receivers) are capable of receiving direct frequencies in the range of approximately 49 MHz to 861 MHz. If the transmitter is not in this range then a down-converter is used to convert the frequency to this range. The frequency from the down-converter is called the IF (intermediate frequency) which is fed to the receiver.

  Down-converters have a LO (local oscillator) which is mixed with the transmitter frequency (SDMT) and converts it to the IF frequency. MDRs need to know the LO (local oscillator) of the down-converter and is factory programmed with this information (MSRs also need the LO information but is not factory programmed with this information). The receiver then automatically calculates the IF frequency once the RF (transmitter frequency) is entered. Thus as the desired RF frequency is dialed in on the MDR (or MSR) the IF is taken care of automatically. For example, if the transmitter frequency (HPMT) is set for 2000 MHz, then the MDR can be set for 2000 MHz (it automatically calculates the IF frequency based on pre-programmed LO information of the down-converter). The IF frequency changes as the RF frequency changes; the LO remains constant.

On non-GMS commercial digital receiver it may be necessary to program the receiver with the IF frequency directly. The user may have to do the simple math to arrive at the IF frequency so that it can be entered into the receiver. ***The down-converter LO must be known***. The math involve is as follows: " RF (transmitter frequency) – LO (local oscillator) = IF frequency". For example, it the transmitter is set for 2000 MHz and the LO of the down-converter is 2800 MHz then the IF frequency is -800 MHz (2000-2800 MHz = -800). The receiver will need to be set to 800 MHz to receive the transmitter frequency of 2000 MHz. Each time the transmitter frequency is changed the IF must be re-calculated and entered into the receiver. It must also be mentioned, as you may have noticed, a negative LO may indicate the receiver wants the signal to be inverted. See section 6.3.3.2 for inverting the signal.

7.2 Local and Remote Power

Customers may have the option of using remote or local power to power up a down converter depending on the receiver used. GMS' MDRs (Messenger Digital Receiver) and MSRs (Messenger Smart Receiver) can provide DC +12 volts to power the D/C remotely through the RF cables. Refer to GMS' MDRs or MSRs operating instructions for turning on the DC power for the D/C when using remote power.

If the D/C is located relatively close to the receiver then using remote power makes sense. However, if the D/C is located at great distances away from the receiver there may be excessive DC voltage drop in the coax cable (due to cable resistances). If this is the case then local DC power should be considered as discussed below. If unsure of the DC voltage drop measure the DC voltage present (using a DMM) at the end of the coax cable run. The D/C normal operating voltage is approximately +12Vdc but can operate down to +10Vdc.

- Local power is provided by applying +12Vdc to pin 1, GND to pin 3 of the DB-9 connector located on the bottom of the D/C. The +12 Volt power supply must be able to source at least 500 mA. The power switch (located on the side of the D/C) enables the user to control the 'ON'/'OFF' positions for local

power. If using local power then ensure the remote power (if the receivers have this capability) is turned off.

-

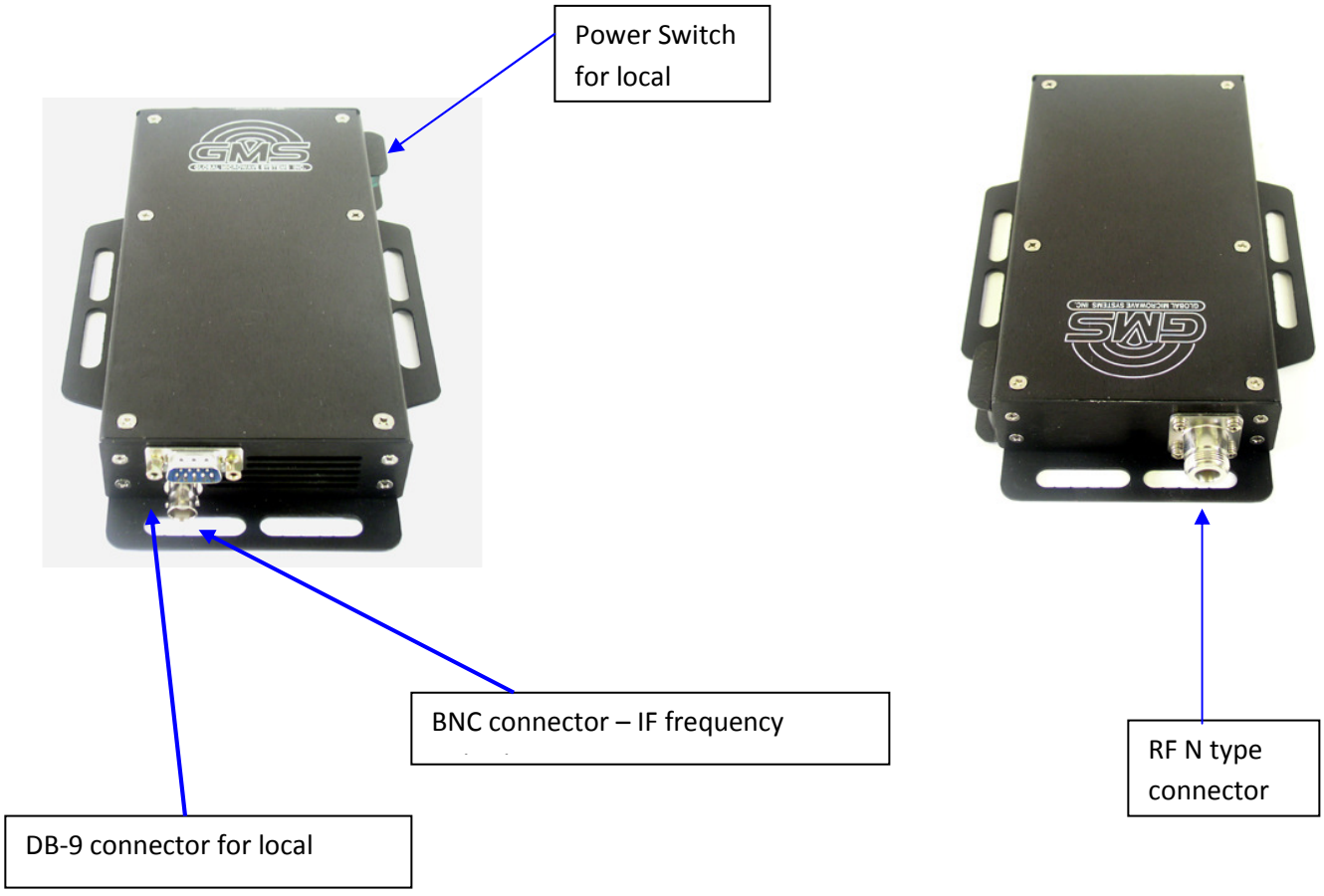


Figure 11- BDC Connectors

Table 2 - DB-9 Connector Pin Out for the D/C

Pin	Signal	Notes
1	+12Vdc	Power supply must be able to source at least 500mA. Voltage should not drop below +10Vdc.
3	GND	Power ground
2, 4-9	NC	Not Connected

8.0 Cable Losses

8.1 Coax Cable

Cable losses must be taken into consideration if the D/C is located a great distance from the receiver. As mentioned above long cable runs can contribute to more resistance in the lines and also can contribute to signal attenuation because of the additional capacitance. Even when using a good coax cable such as RG59/U the attenuation of the signal can be significant. For example, RG59/U coax will drop approximately 2 dB per 100 feet at 50 MHz and 8dB per 100 feet at 900 MHz. The intermediate frequency (IF) in this system can fall between 49 MHz to 850 MHz. An inline amplifier matching the cable losses should be considered if losses exceed 6 dB

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0285X1	X1	INITIAL RELEASE	12/22/04 SLP	
E0438	X1A	UPDATE DWG TO REFLECT AS BUILT	07/08/05 SLP	

NOTES:
1. REFERENCE BOM 780-C0219X1A FOR PART REFERENCE DESIGNATORS (SHOWN AS [] ON DRAWING)AND DESCRIPTIONS.
2. DIMENSIONS SHOWN ARE INCHES.
3. LABEL FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0219X1A USING BEST COMMERCIAL METHOD.

CABLE ASSEMBLY INSTUCTIONS

1. CUT CABLE [W1] TO 48.0. TRIM CABLE JACKET TO EXPOSE WIRES AS SHOWN. STRIP WIRES AT BOTH ENDS AND PRE-TIN AT 0.75 END ONLY. REFERENCE FIGURE 1.

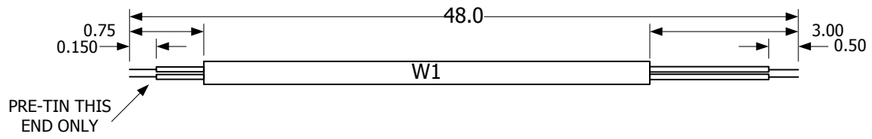


FIGURE 1

2. CUT WIRES [W2] AND [W3] TO DIMENSIONS AS SHOWN IN FIGURE 2. STRIP AND PRE-TIN WIRES AT BOTH ENDS.

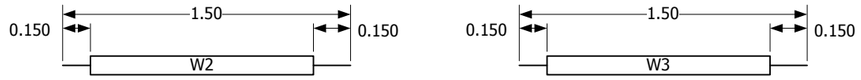


FIGURE 2

3. REMOVE STRAIN RELIEF AND COMPRESSION GASKET FROM [P8] CONNECTOR BODY. ROUTE WIRES THROUGH COMPRESSION GASKET AS SHOWN IN FIGURE 3. COVER ENDS OF WIRES WITH 0.25 LENGTH OF HEATSHRINK [SLV1]. SOLDER WIRES TO CONNECTOR [P8]. COVER SOLDER JOINT WITH HEATSHRINK AND SHRINK HEATSHRINK. REFERENCE FIGURE 3.

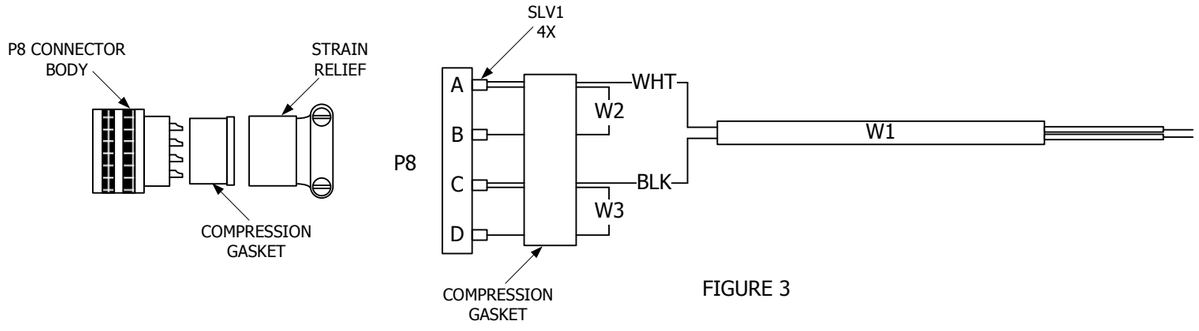


FIGURE 3

4. CUT 2 PIECES OF HEATSHRINK [SLV2] TO 0.50 AND COVER TRIMMED ENDS OF CABLE [W1] JACKET. SHRINK HEATSHRINK [SLV2]. RE-ATTACH P8 STRAIN RELIEF TO CONNECTOR BODY. REFERENCE FIGURE 4.

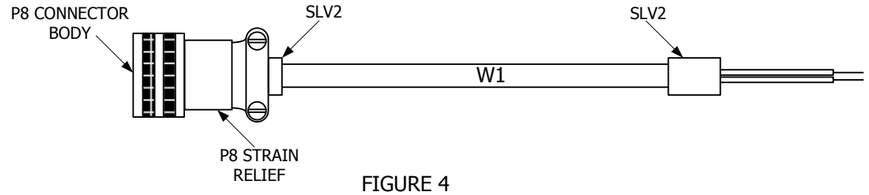


FIGURE 4

5. ATTACH BANANA PLUGS [P1] AND [P2] TO CABLE [W1] WIRES AS SHOWN IN FIGURE 5. LABEL CABLE ASSEMBLY WITH PART NUMBER (REFERENCE NOTE 3) AND "DC POWER" USING BEST COMMERICIAL METHOD, APPROXIMATELY WHERE SHOWN. REFERENCE FIGURE 5.

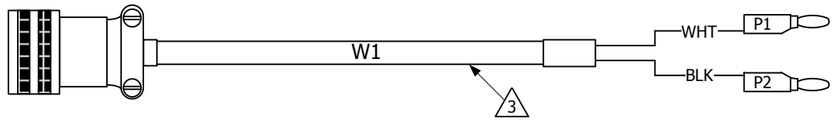


FIGURE 5

ENG/TECH		COBHAM GMS Products	DWG TITLE: CABLE,EXTERNAL,P8,MHPT
DRAWN	SLP	SIZE:	DATE: 12/22/04
ENG		DWG NO: 100-C0219X1A	REV: X1A
PROD		SCALE: NONE	SHEET: 1 OF 1
QC			

NOTES:

1. REFERENCE BOM 780-C0218X2 AND OR LATEST MINOR REVISION FOR PART REFERENCE DESIGNATORS (SHOWN AS [] ON DRAWING)AND DESCRIPTIONS.
2. DIMENSIONS SHOWN ARE INCHES.
3. LABEL FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0218X2 USING BEST COMMERCIAL METHOD APPROXIMATELY WHERE SHOWN

DRAFT

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0285X1	X1	INITIAL RELEASE	12/22/04 SLP	
E0438	X1A	UPDATE DWG TO REFLECT AS BUILT	07/08/05 SLP	
E1292	X2	CHG P7 TO MALE (PIN) CONNECTOR	10/16/09 SLP	

CABLE ASSEMBLY INSTRUCTIONS

1. CUT CABLE [W1] TO 36.0. SEPERATE RED AND BLACK CABLES AS SHOWN IN FIGURE 1. TRIM JACKET TO EXPOSE FOIL SHIELD AND WIRES, TRIM FOIL SHIELD FLUSH WITH CABLE JACKETS LEAVING RED AND BLACK WIRES AND SHIELD DRAIN WIRE EXPOSED.

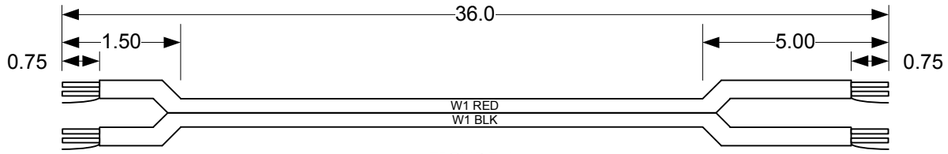


FIGURE 1

2. DIS-ASSEMBLE CONNECTORS [P1] AND [P2] AND THREAD RED AND BLACK CABLE THRU CONNECTOR STRAIN RELIEFS. STRIP RED AND BLACK WIRES OF EACH CABLE AS SHOWN AND PRE-TIN WIRES. COVER WIRES AND SHIELD DRAIN WIRE WITH 0.25 LENGTH OF HEATSHRINK [SLV1]. REFERENCE FIGURE 2.

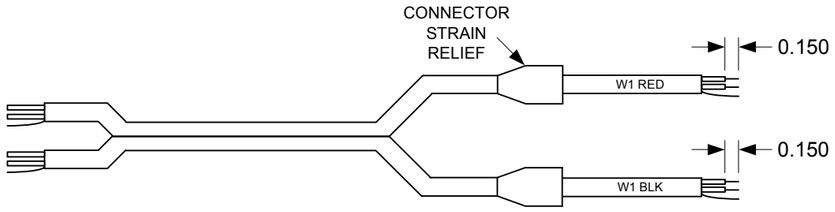


FIGURE 2

3. SOLDER WIRES TO CONNECTORS [P1] AND [P2] AS SHOWN IN FIGURE 3. COVER SOLDER JOINT WITH HEATSHRINK [SLV1], AND SHRINK HEATSHRINK. RE-ASSEMBLE CONNECTOR WITH STRAIN RELIEF. LABEL [P1] WITH "AUDIO 1" AND [P2] WITH "AUDIO 2" USING BEST COMMERICIAL METHOD.

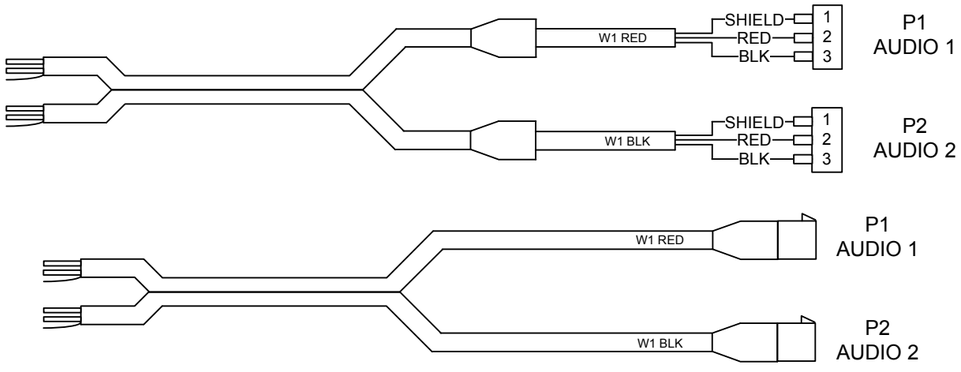


FIGURE 3

4. USING WIRE [W2] MAKE 2 JUMPERS AS SHOWN IN FIGURE 4. PRE-TIN BOTH ENDS OF JUMPER.

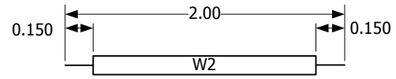


FIGURE 4

5. STRIP AND PRE-TIN WIRES AS SHOWN IN FIGURE 5. REMOVE STRAIN RELIEF FROM CONNECTOR [P7] AND THREAD CABLE THROUGH STRAIN RELIEF. COVER ENDS OF WIRES WITH 0.25 LENGHT OF HEATSHRINK [SLV1].

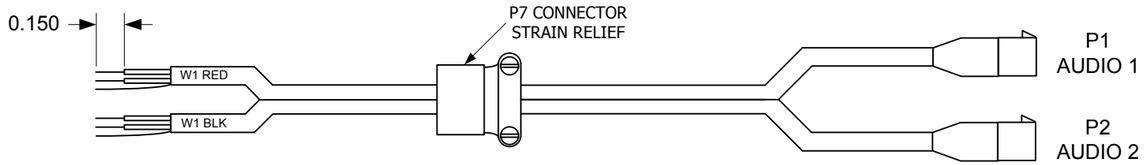


FIGURE 5

6. ROUTE WIRES THROUGH CONNECTOR COMPRESSION GASKET AND SOLDER WIRES TO CONNECTOR [P7] AS SHOWN IN FIGURE 6. ADD JUMPER [W2] WHERE SHOWN. REFERENCE FIGURE 6.

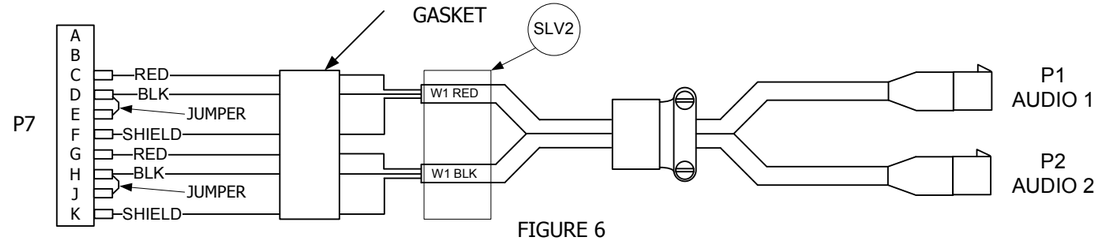


FIGURE 6

7. RE-ATTACH CONNECTOR STRAIN RELIEF. MARK CONNECTOR [P7] WITH "P7" USING BEST COMMERICIAL METHOD. LABEL CABLE ASSEMBLY, REFERENCE NOTE 3, USING BEST COMMERICIAL METHOD.

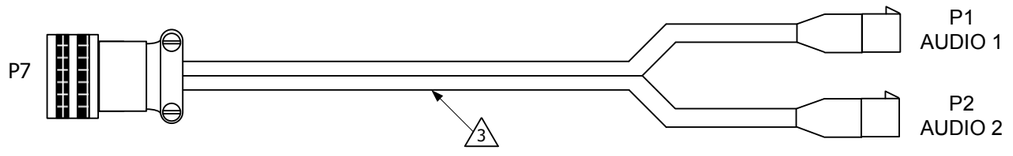


FIGURE 7

TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING LINEAR X.X = ± 0.5 X.XX = ± 0.125 X.XXX = ± 0.020	ENG/TECH	COBHAM GMS Products	DWG TITLE CABLE,EXTERNAL,P7,MHPT
	DRAWN SLP		
	ENG	SIZE / DATE 12/22/04 / DWG NO 100-C0218X2 / REV X2	
	PROD		
	QC	SCALE NONE / BOM 780-C0218X2 / SHEET 1 OF 1	

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
E0285X1	X1	INITIAL RELEASE	12/21/04	SLP
E0438	X2A	UPDATE CABLE DWG TO REFLECT AS BUILT	07/08/05	SLP
E1080	X3	CHG P6 TO MALE (PIN) CONNECTOR	11/10/08	SLP
E1292	X4	CHG P6 TO FEMALE (SOCKET) CONNECTOR	10/16/09	SLP

NOTES:

1. REFERENCE BOM 780-C0217X4 AND OR LATEST MINOR REVISION FOR PART REFERENCE DESIGNATORS (SHOWN AS [] ON DRAWING) AND DESCRIPTIONS.
2. LABEL FINAL CABLE ASSEMBLY WITH PART NUMBER 780-C0217X4 USING BEST COMMERCIAL METHOD, APPROXIMATELY WHERE SHOWN.

DRAFT

CABLE ASSEMBLY INSTRUCTIONS

1. CUT 2 PIECES OF CABLE [W1] TO 36.00 ±0.50. PERFORM STEPS 1 AND 2 TO BOTH PIECES OF CABLE [W1]. AT ONE END, TRIM CABLE JACKET AND FOLD CABLE SHIELD BACK OVER JACKET TO EXPOSE WIRES. AT OTHER END, TRIM CABLE SHIELD FLUSH WITH CABLE JACKET. CUT WHITE WIRE FLUSH WITH CABLE JACKET AT BOTH ENDS. STRIP WIRES AND PRE-TIN AS SHOWN. REFERENCE FIGURE 1.

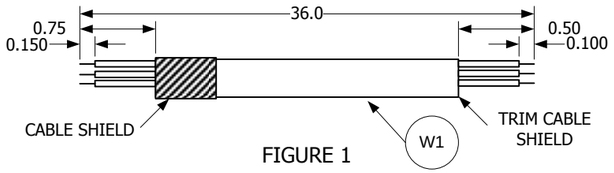


FIGURE 1

2. PRE-TIN EACH CABLE [W1] SHIELD. MAKE A SHIELD DRAIN WIRE, 2 EACH, AS SHOWN USING WIRE [W3]. PRE-TIN BOTH ENDS. SOLDER DRAIN WIRES [W3] TO CABLE SHIELD. COVER SHIELD WITH 0.5 LENGTH OF HEAT SHRINK [SLV2] AND SHRINK HEATSHRINK. REFERENCE FIGURE 2.

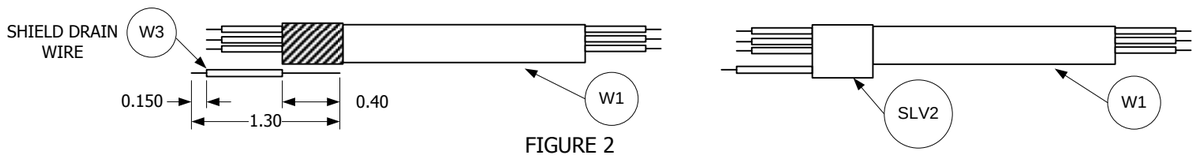


FIGURE 2

3. CUT CABLE [W2] TO LENGTH AS SHOWN IN FIGURE 3. TRIM CABLE JACKET, SHIELD AND FOIL TO EXPOSE WIRES. STRIP AND PRE-TIN WIRES.

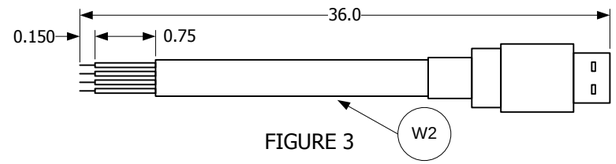


FIGURE 3

4. IF ATTACHED, REMOVE STRAIN RELIEF AND COMPRESSION GASKET FROM CONNECTOR [P6]. ROUTE WIRES FROM 2 EACH [W1] CABLES AND [W2] CABLE THROUGH COMPRESSION GASKET AND COVER WIRES WITH 0.25 LENGTH HEATSHRINK [SLV1]. SOLDER WIRES TO CONNECTOR [P6] AS SHOWN IN FIGURE 4. COVER SOLDER JOINT WITH HEATSHRINK AND SHRINK HEATSHRINK. THREAD CABLES THRU [P6] STRAIN RELIEF CLAMP AND SNUGGLY TIGHTEN CLAMP AROUND CABLES.

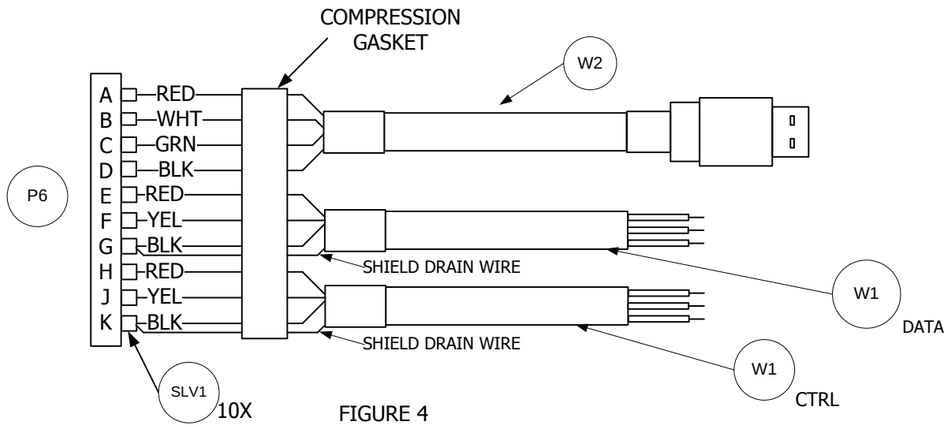


FIGURE 4

5. COVER TRIMMED END OF CABLE JACKET [W1] DATA AND [W1] CTRL WITH 0.50 LENGTH HEATSHRINK [SLV2] AND SHRINK HEATSHRINK. COVER WIRES WITH 0.25 LENGTH HEAT SHRINK [SLV1] AND SOLDER WIRES TO CONNECTORS [P1] AND [P2] AS SHOWN IN FIGURE 5. COVER SOLDER JOINT WITH HEATSHRINK AND SHRINK HEAT SHRINK.

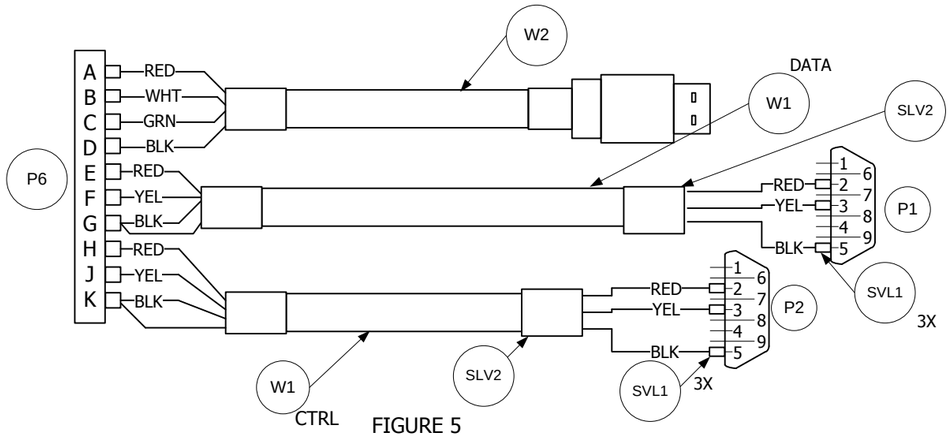


FIGURE 5

6. ATTACH BACKSHELLS [SH1] TO CONNECTORS [P1] AND [P2]. LABEL BACKSHELL FOR [P1] WITH "DATA", LABEL BACKSHELL FOR [P2] WITH "CTRL" USING BEST COMMERICIAL METHOD. LABEL [P6] CONNECTOR WITH "P6", USING BEST COMMERICIAL METHOD. REFERENCE FIGURE 6.

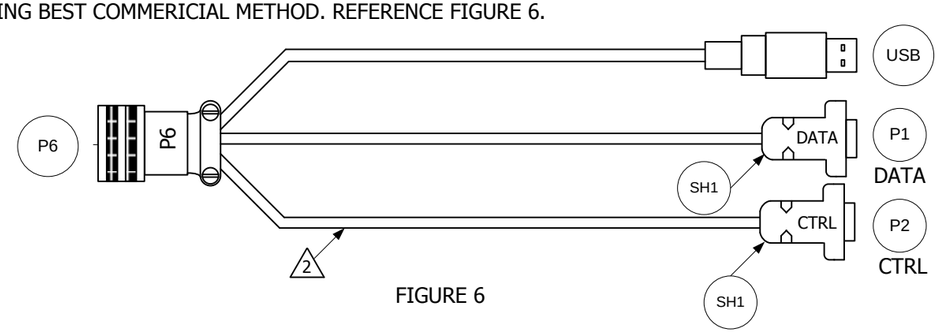


FIGURE 6

TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING LINEAR X.X = ± 0.5 X.XX = ± 0.125 X.XXX = ± 0.020	ENG/TECH	COBHAM GMS Products	DWG TITLE CABLE,EXTERNAL,P6,MHPT
	DRAWN SLP		
	ENG	SIZE	DATE 12/21/04
	PROD	DWG NO 100-C0217X4	REV X4
	QC	SCALE NONE	BOM: 780-C0217X4 SHEET 1 OF 1